

CLAIMS

What is claimed is:

1. An apparatus for placing a plurality of conductive spheres on a substrate, comprising:
a stencil plate with upper and lower surfaces and a first pattern of a plurality of through-holes, said stencil plate configured to place ~~a plurality of~~ ^{The} conductive spheres in said first pattern on a proximate surface of a substrate;
a hopper extending across at least a portion of said upper surface of said stencil plate and proximate thereto, said hopper having a bottom opening with a dimension extending across said first pattern for dispensing said spheres into the through-holes of said stencil plate; and
apparatus for moving said hopper over said first pattern relative said stencil plate to place said spheres into said through-holes and thereby onto said proximate surface of said substrate.

2. The apparatus of claim 1, wherein said spheres drop into and pass downwardly through said through-holes by gravitational force.

3. The apparatus of claim 1, wherein said first pattern corresponds to a pattern of bond pads on said substrate.

4. The apparatus of claim 1, wherein ~~said apparatus~~ for moving said hopper is configured to move said hopper between stencil plate areas on opposed sides of said second pattern, said stencil plate areas having no through-holes.

5. The apparatus of claim 1, wherein the diameter of said through-holes of said first pattern are greater than the diameter of said spheres by up to 1 mm.

Xy 6. The apparatus of claim 1, wherein said stencil plate is spaced from said substrate to restrain said spheres dropped onto said substrate within said first pattern.

5 7. The apparatus of claim 1, wherein said stencil plate is spaced from said substrate to restrain said spheres dropped onto upwardly projecting prefluxed bond pads of said substrate.

8. The apparatus of claim 1, wherein said stencil plate is spaced from said substrate to restrain said spheres dropped onto depressed bond pads of said substrate.

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9. An apparatus for placing conductive spheres on a substrate, comprising:
a stencil plate with a first pattern of a plurality of through-holes, said stencil plate
configured to place a plurality of conductive spheres in said first pattern on a
surface of a substrate;
a shuttle plate parallel to said stencil plate and proximate thereto, said shuttle plate having
a second pattern of through-holes corresponding to said first pattern;
apparatus for moving said shuttle plate from a first position wherein said first and second
patterns are axially aligned to a second position wherein said first and second
patterns are non-aligned; and
20 conductive sphere supply means for placing said conductive spheres in said first pattern of
through-holes.

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10. The apparatus of claim 9, wherein said supply means is configured to place
said conductive spheres in said first pattern of through-holes when said shuttle plate is in
said second position.

11. The apparatus of claim 9, wherein said supply means is configured to place
said conductive spheres in said first pattern of through-holes when said shuttle plate is in
said first position.

12. The apparatus of claim 9, wherein said first pattern corresponds to a pattern of bond pads on said substrate.

5 13. The apparatus of claim 9, wherein said sphere supply means comprises a bottomless container with side walls extending downward to proximate said movable shuttle plate, wherein said spheres drop into said through-holes of said second pattern as said shuttle is moved, said side walls encompassing a major portion of said first pattern.

10 14. The apparatus of claim 9, wherein said sphere supply means comprises a container having a bottom with a third pattern of through-holes corresponding to said second pattern.

15 15. The apparatus of claim 14, wherein said third pattern is aligned with said first pattern.

16. The apparatus of claim 14, wherein said third pattern is non-aligned with said first pattern.

20 17. The apparatus of claim 9, wherein the diameter of said through-holes of said second pattern are greater than the diameter of said spheres by up to 1 mm.

25 18. An apparatus for positioning a plurality of conductive spheres on a substrate, each conductive sphere of said plurality of conductive spheres having a diameter, said apparatus comprising:
a stencil plate having an upper surface, having a lower surface, and having a first pattern of a plurality of through-holes, each through-hole having a diameter, said stencil plate configured to position a plurality of conductive spheres in said first pattern on a proximate surface of a substrate;

a hopper extending across at least a portion of said upper surface of said stencil plate and proximate thereto, said hopper having a bottom opening with a dimension extending across said first pattern for dispensing said spheres into the through-holes of said first pattern of said stencil plate; and

- 5 ✓apparatus for moving said hopper over said first pattern relative of said stencil plate to position said spheres into said through-holes and thereby onto said proximate surface of said substrate.

- ✓19. The apparatus of claim 18, wherein said spheres drop into and pass
downwardly through said through holes by gravitational force.

20. The apparatus of claim 18, wherein said first pattern corresponds to a pattern of bond pads on said substrate.

21. The apparatus of claim 18, wherein said apparatus for moving said hopper is configured to move said hopper between stencil plate areas on opposed sides of said second pattern, said stencil plate areas having no through-holes.

22. The apparatus of claim 18, wherein the diameters of said through-holes of said first pattern are greater than the diameters of said plurality of spheres by up to 1 mm.

23. The apparatus of claim 19, wherein said stencil plate is spaced from said substrate to restrain said spheres dropped onto said substrate within said first pattern.

- 25 24. The apparatus of claim 20, wherein said stencil plate is spaced from said substrate to restrain said spheres dropped onto upwardly projecting prefluxed bond pads of said substrate.

25. The apparatus of claim 20, wherein said stencil plate is spaced from said substrate to restrain said spheres dropped onto depressed bond pads of said substrate.

26. An apparatus for positioning conductive spheres on a substrate, each sphere having a diameter, said apparatus comprising:
5 a stencil plate with a first pattern of a plurality of through-holes, each through-hole having a diameter, said stencil plate configured to position a plurality of conductive spheres in said first pattern on a surface of a substrate;
a shuttle plate parallel to said stencil plate and proximate thereto, said shuttle plate having
10 a second pattern of through-holes corresponding to said first pattern, each through-hole of said second pattern of through-holes having a diameter; apparatus for moving said shuttle plate from a first position wherein said first and second patterns are substantially aligned to a second position wherein said first and second patterns are non-aligned; and
15 conductive sphere supply means for positioning said conductive spheres in said first pattern of through-holes.

27. The apparatus of claim 26, wherein said sphere supply means is configured to position said conductive spheres in said first pattern of through-holes when said shuttle plate is in said second position.
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28. The apparatus of claim 26, wherein said supply means is configured to position said conductive spheres in said first pattern of through-holes when said shuttle plate is in said first position.
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29. The apparatus of claim 26, wherein said first pattern corresponds to a pattern of bond pads on said substrate.

30. The apparatus of claim 26, wherein said sphere supply means comprises a bottomless container with side walls extending downwardly to proximate said shuttle plate, wherein said spheres drop into said through-holes of said second pattern as said shuttle plate is moved, said side walls encompassing a major portion of said first pattern.

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31. The apparatus of claim 26, wherein said sphere supply means comprises a container having a bottom with a third pattern of through-holes corresponding to said second pattern.

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32. The apparatus of claim 31, wherein said third pattern is aligned with said first pattern.

33. The apparatus of claim 31, wherein said third pattern is non-aligned with said first pattern.

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34. The apparatus of claim 26, wherein the diameters of said through-holes of said second pattern are greater than the diameters of said spheres by up to 1 mm.